OSU Working Papers in Linguistics 53, 31-70

Tonal Associative Morphemes in Optimality Theory*

Michael Cahill
cahill@ling.ohio-state.edu

Associative (= possessive or genitive) morphemes in many African languages consist solely of a tone. In a sample of 29 languages, this tonal morpheme is manifested on either the head noun or the noun to the right. It is never manifested on a dependent noun to the left. These patterns are analyzed as the result of two constraints. The first constraint, TONE-RT, states that surface tones associate to the right of their underlying positions. The other constraint, HEAD-PROM, states that heads rather than non-heads attract phonetic prominence. These constraints are supported by a variety of cross-linguistic evidence, and their interaction is illustrated from a variety of languages. In the complex case of the Makaa language of Cameroon, the associative morpheme docks left in some instances and right in others. I show that in Makaa, HEAD-PROM outranks TONE-RT, but is itself outranked by other constraints, giving the alternate directions of docking.

1. Introduction

In Optimality Theory, constraints have been proposed to be universal (Prince & Smolensky 1993). If this is true, then these constraints would be expected to be active cross-linguistically. Thus for any such proposed universal constraint to be well-supported, it is worthwhile for the investigator to examine data from a wide variety of languages. Examining cross-linguistic data relating to a particular phenomenon may in turn yield previously unsuspected generalizations, which then can be translated into constraints. These constraints may in turn lead to new and more insightful analyses of previously-analyzed data. Casali's (1997) work on vowel elision in hiatus is a case in point. As a result of examining several dozen languages in which vowel elision occurs in hiatus contexts, he proposed a small set of general constraints which in various

* My thanks to Mary Bradshaw and Sam Rosenthall for playing devil's advocate and for discussion of certain points in this study, and particularly to Mary Beckman, Beth Hume, Keith Johnson and David Odden for incisive and constructive comments on the whole paper. All oversights, foibles, blunders, fuzzy thinking, errors in logic, displays of ignorance, and other shortcomings are of course my responsibility, not theirs.

combinations of rankings account for all the attested patterns of elision, rather than the purely stipulative rule-based accounts previously available for individual languages.

Another area in which the same approach has proved fruitful is examined in this paper. This is the area of floating tonal morphemes marking the associative construction in noun phrases. By examining constructions from a variety of languages, we can derive some generalizations which account for the patterns found, but have not been previously noted for any of the individual languages.

This paper is organized as follows. In Section 2, after a brief look at associative morphemes which are purely segmental, I present data from 29 languages in which the associative morpheme is purely tonal, showing that the realization of the associative morpheme is always either on the head noun or to the right (or both). In Section 3, I motivate two basic constraints which will be central to the analysis of these morphemes, **TONE-RT** (tones "move" rightward) and **HEAD-PROM** (heads are phonetically prominent), and use these to analyze the possible patterns of associative tonal behavior in the languages listed. The more complex situation of the Makaa language, in which the associative tone docks in different directions depending on the context, is examined more closely.

2. The data

2.1 Segmental associative morphemes

In an associative construction (also called genitive or possessive), the head noun is the possessed one; the dependent noun is the possessor. Nichols (1986) shows that cross-linguistically, the associative relation can be morphologically marked on either the head noun or its dependent.[1] For example, she cites the two Caucasian languages Chechen and Abkhaz as marking the dependent noun and the head in associative constructions, respectively (superscripts H and A mark the Head noun and the Associative Marking):

[1] My thanks to Arnold Zwicky for pointing out this reference.

(1) Chechen: de:-ˆn ʰa:xča 'father's money'
father-GEN money

Abkhaz: à-č'kº'ən ˆyə-ʰyºnə 'the boy's house'
the-boy his-house

Which noun a segmental associative morpheme attaches to, then, can be purely a language-specific matter of the morphology. Other cases can be easily adduced.

For English, the *'s* marker attaches left to the dependent noun, e.g. *chair's leg*, as in the Chechen case above, while in Hausa, the *-n* or *-r* associative marker attaches left to the head noun (Cowan & Schuh 1976):

(2) a. agogo-n malam
watch-of teacher
'teacher's watch'

b. tunkiya-r Maryama
sheep-of Maryama
'Maryama's sheep'

Other languages can mark the genitive relationship to the dependent noun to the right:

(3) Modern Greek[2]
kɛfaʎ-a kot-on 'chicken's head'
head-SG.NOM chicken-GEN.PL

(4) Gaelic
taigh bhalaich 'boy's house' (cf. balach 'boy (nom)')
house (nom) boy **(gen)**

Examples may be multiplied from the reader's experience. With segmental morphemes, an associative or possessive marker may attach to the head or the dependent noun, to the left or to the right. All combinations are found, and it does not seem that any are rare. In contrast, a more restricted pattern applies to purely tonal associative morphemes.

2.2 Tonal associative morphemes

In the African context, the associative morpheme consisting entirely of tone arose historically from a morpheme which had segmental as well as tonal content. This morpheme occurred between the possessed and possessor nouns, in conformity with Greenburg's word-order universals (Greenburg 1966). When the segmental content, often

[2] My thanks to Panos Pappas and Tom Stewart for supplying the Greek and Gaelic examples.

a vowel, was lost, the tonal effect remained behind (see discussion in Welmers 1963). In this section I present data from languages which synchronically have an associative morpheme consisting solely of tone. The much-analyzed Bamileke-Dschang (Hyman 1985), which has associative markers consisting of segmental as well as tonal material, is a borderline case, since the segmental part of the associative marker frequently elides, leaving only tonal effects. All the examples in this paper are from African languages, though from several language families. Whether tonal languages from other areas of the world, such as Asia or Meso-America, have associative morphemes consisting solely of tone remains to be seen.

For the first language I examine, I explicitly lay out the reasoning that causes the analyst to posit a separate morpheme consisting solely of tone. In languages following, I merely present the data for the reader's examination, and assume the same type of analysis. The language data is grouped by families below. The diacritics (̀, ́, ̂, ̌, ̄, ꜜ) will respectively symbolize Low, High, Falling, Rising, Mid, and Downstep below unless otherwise indicated.

2.2.1 Gur

In Kɔnni, a Gur language of northern Ghana, a segmentless High tone is the morpheme which marks the associative construction in third person, as in 'his stone' or 'child's stick'. The evidence for this is that the head noun of every such construction for third person as possessor has a High tone on its initial syllable. It is only the third person, singular or plural, that has the High tone as associative marker:

(5)	1st	2nd	3rd	3rd non-human	
singular	ǹ dàáŋ	fǐ dàáŋ	ù dáꜜáŋ	kà dáꜜáŋ	'my, *etc.* stick'
plural	tǐ dàáŋ	nǐ dàáŋ	bà dáꜜáŋ	à dáꜜáŋ	

If the head noun already has a High tone on its first syllable in citation form, then there is no change when it is placed in an associative construction. Examples are given below with both pronouns and nouns as possessors.

(6) a.

tǎŋ	ù tá!ŋ̀[3]	'stone, his stone'
zàsíŋ	ù zá!síŋ	'fish, his fish'
dàmpàlá	ù dám!pálá	'bench, his bench'

b.

bùàwá dá!áŋ	'child's stick'	(cf. bùàwá 'the child', dàáŋ 'stick')
bùá kárɛ́ntɪ̀à	'child's cutlass'	(cf. bùá 'child', kàrɛ́ntɪ̀à 'cutlass')
chòrú dám!pálá	'husband's bench'	(cf. chòrú 'husband', dàmpàlá 'bench')

The alternation between the initial Low for head nouns in citation form and the initial High in the associative construction is explained by the existence of a High tone between the two nouns. The High will dock to the head noun, giving the observed pattern of a High tone on the first syllable (sometimes as part of a H!H contour on that syllable, as in 'stone' and 'stick' above).

(7)

L	H	L H		L	H L H		
|		| |	→	|	\ /		
u		zasɪŋ		u	zasɪŋ	ù zá!síŋ	'his fish'

In Moore, it appears that the same pattern occurs (adapted from Peterson 1971).

(8) sáánà + dòògó → [sáánà dóó!gó] 'stranger's house'
stranger house

A similar pattern also appears to occur in the related language Dagbani (Goad 1988):

(9) nàá + nàá → [nàá ná!á] 'chief's chief'
chief chief

In Senoufo, the same pattern of a High associating right to the head noun occurs, but its realization seems to be optional (Mills 1984).

(10) lòmúrúw̌ + lɔ̀ʔɔ̀ → lòmúrúw̌ lɔ́ʔɔ́ ~ lòmúrúw̌ lɔ̀ʔɔ̀ 'the lemon's juice'
lemon water

[3] The form tá!ŋ̀ has a contour tone of High-downstepped High on a single syllable. Rather than attempting to write H!H on the [a], I have written the downstepped High tone on the nasal for convenence' sake

2.2.2 Adamawa-Ubangi

In the Adamawa-Ubangi family, the Suma language of the Central African Republic as analyzed by Bradshaw (1995a, b) has a floating [+upper] or "high register" feature that marks the associative construction. Suma has three pitch levels, and in Bradshaw's analysis, [+upper] characterizes both Mid and High tones. Thus a floating [+upper] will have no effect on Mid and High (11a-b), since they are already [+upper], but will only affect nouns ending in a Low tone (11c-d), as follows:

(11) a.	zàká	+	sàɗè	→	zàká sàɗè	'animal horn'
	horn		animal			
b.	kōy	+	kàm	→	kōy kàm	'leftover food'
	remains		food			
c.	kpárè	+	fón	→	kpáré fón[4]	'millet seeds'
	seeds		millet			
d.	rì	+	bèrè	→	rī bèrè	'breast milk'
	water		breast			

Thus the [+upper] associative morpheme docks left, to the head noun. The difference in Low changing to High in (c) and Low changing to Mid in (d) is due to additional tone rules (note the following word begins with High in (c) and Low in (d)).

The Ali language is spoken in Central African Republic and has the same type of pattern (Monino 1987, English glosses supplied by M. Bradshaw):

(12) a.	zù	+	sàdì	→	zū sàdì	'animal head'
	head		animal			
b.	sālā	+	tè	→	sálá tè	'body hair'
	hair		body			

The Mumuye language, Zing dialect, is spoken in Nigeria, and has two types of genitive construction (Shimizu 1983). In one of these, the head noun is to the right with no associative marker between it and the dependent possessor noun. This type is generally limited to cases in which the possessor is animate. In the more general case, used for both animate and inanimate possessors, which we will consider here, the head noun is on the left and the associative tone docks to it.

[4] Note typo in Bradshaw 1995a, in which the form is listed incorrectly as kpárè fón (Bradshaw, pc).

(13)	a.	yūū head	+	nàpō cow	→	yúú nàpō 'head of cow'
	b.	tnárī teeth	+	zāā dog	→	tnárí zāā 'teeth of dog'
	c.	kìǹ chicken	+	kpàǹtī chief	→	kìń kpàǹtī 'chicken of chief'

2.2.3 Kwa

In Dolphyne (1988), we see that a High associative tone in the Kwa language Akan between nouns normally docks to the head noun, to the right (see also Dolphyne 1986, Nyaggah 1976):

(14) Kòfí nyá!mé 'Kofi's god' Kòfí Nyàmé 'Kofi Nyame' (proper name)
(cf. nyàmé 'god')

Welmers (1963:439,441) mentions Akan as having an associative Low tone, but his data deals with compounds rather than the Noun + Noun associative constructions cited above. Forming a compound *word* involves different processes than forming an associative *construction.*[5]

2.2.4 Kru

In Bété de Gbadi (Charette 1983), the head noun is to the right. There are four tones: High, Mid-High, Mid, and Low. The Mid-High is unmarked in the transcriptions below (my translation from the French glosses).

[5] For example, in Kɔnni, a compound noun's first noun stem lacks a suffix, and there is no tonal perturbation traceable to any separate morpheme, while in the associative construction, both nouns have their respective suffixes and there is a tonal perturbation traceable to a morpheme distinct from either noun, as in (5-6).

(15) a. glìmɔ̀ yu → glìmɔ̀ yù 'agouti's child'
agouti child

b. sìpu yu → sìpú yū 'cat's child'
cat child

c. yu du → yú dù 'child's village'
child village

d. nɛ̄mɛ̄ g^{w}i → nɛ̄mɛ̄ g^{w}ì 'animal's horns'
animal horns

e. sū dádɛ̀ → sū dădɛ̀ 'wooden pipe'
tree pipe

f. g^{w}i lɔ̄→ g^{w}i lɔ̀ 'elephant totem'
totem elephant

g. yu ɓùdù → yú ɓùdù 'child's house'
child house

h. sū gbɛ̀ → sū gbɛ̀ 'wooden totem'
tree totem

Though there are several complexities which we will not examine here,[6] a general pattern is evident. The head noun, to the right, is lower in tone in associative construction than in isolation form (cf. especially 'child' in a, b, c, and g). Charette analyzes this as due to a floating associative Low tone which docks right.

2.2.5 Chadic

In the Chadic language Ga'anda, the dependent noun, to the right in an associative construction, is marked by an initial High tone (Kenstowicz 1994):

(16) a. āl + cùnèwà → āl cúnèwà 'bone of elephant'
bone elephant

b. ɓár + pūnó → ɓár pú'nó 'husk of maize'
bark maize

[6] For example, many of the Mid-High tones word-finally in citation forms are analyzed by Charette as underlyingly High, with a rule of final Lowering giving the surface Mid-High. Thus the apparent change of yu to yú in noun 1 position is not due to any tonal rule applying, but rather that Lowering does not apply when yu is not utterance-final. It should be noted also that Charette analyzes citation Mid tones as underlyingly toneless.

2.2.6 Benue-Congo: Cross River

For Efik, Ward (1933) reports a "genitive tone" in possessive constructions. This appears to be a High tone which associates to the right, to the dependent noun, as seen from the data adapted from Ward (1933:42)

(17) a.	èkpàt	èdèm	ékpàt	'bag's outside (outside of the bag)'
	bag	outside	bag	
b.	ùbṑm	ísó	úbṑm	'canoe's front (front of the canoe)'
	canoe	front	canoe	
c.	àŋwâ[7]	ìsìm	áŋwâ	'cat's tail'
	cat	tail	cat	

Kana (or Khana) is also classified in the Cross River division of Benue-Congo and spoken in Nigeria. The head noun is to the left, and it is the tone on that noun which can change. Kana has four surface tones: High, Raised, Mid, and Low. The Raised is regarded as derived from a lowered High (Ikoro 1995). A High tone on the head noun never changes, a Low changes only before a Mid (as the result of a separate raising rule, not the associative construction), the Raised changes before any tone except Mid, and Mid changes before any other tone. Changes due to the associative construction are shown below. Raised tone is unmarked.

(18) a.	gbɔ	+	té	→	gbɔ̰ɔ̰̀ té	'wooden fishing net'
	net		tree			
	gbɔ	+	fa	→	gbɔ̰ɔ̰̀ fa	'net of a boat'
	net		boat			
	ko	+	bɔ̀ɔ̀	→	ko̰ò̰ bɔ̀ɔ̀	'dangerous friend'
	friend		danger			
b.	yēb	+	zím	→	yḛ̄ḛ̀b zím	'ancestral dance'
	dance		anc.spirit			
	bē	+	fa	→	bḛ̄ḛ̀ fa	'home of vehicles'
	compound		vehicle			
	yēb	+	dū	→	yeb dū	'market dance'
	dance		market			
	bū	+	dèrè	→	bṵ̄ṵ̀ dèrè	'vulture's stomach'
	stomach		vulture			

[7] Ward's symbols indicate that the falling tone in àŋwâ 'cat' is from Mid to Low, but the text states it is "high--high-fall". The exact phonetics of the second syllable is not crucial to the main point here.

With the exception of 'market dance,' which shows the effect of a Mid raising rule, it can be seen that the first noun shows a Low tone as a result of the associative construction. Thus Kana is an example of a relatively rare Low associative tone which docks.

2.2.7 Benue-Congo: Defoid

Welmers (1973:43-44) reports that the associative construction in some phonological environments in Yoruba is marked with a mid tone that combines with a High ending the first word to give a High-Mid glide on the first word (which is the head noun), or, as in the data below, replaces a low tone ending the first word. See also Welmers (1963, 1970):

(19) a.	ònà	òn̄ā	Èkó	'road to Lagos'
	road	road	Lagos	
b.	àkpò	àkpõ	èkpà	'bag of peanuts'
	bag	bag	peanuts	

2.2.8 Benue-Congo: Igboid

When nouns are put into associative constructions in Igbo, as sketched in Welmers (1963, 1970), one must filter out the effects of other tonal processes to see the effect of the associative marker. But it is clear that, as Welmers concludes, there is an associative High tone in Igbo, as seen in the following data from Welmers (1963), translated from his representation[8]:

(20) a.	ótù	+	ìkó	→	ó!tú !íkó	'unit of cup (i.e. one cup)
	unit		cup			
	ọ́gụ́	+	ìkó	→	ọ́gụ́ !ìkó	'score of cups (i.e. 20 cups)
	score		cup			
b.	ázụ̀	+	ànyí	→	á!zụ́ !ányí	'our fish'[9]
	fish		us			
	ìtè	+	ànyí	→	ìté !ányí	'our pot'
	pot		us			
c.	é!gó	+	ànyí	→	égó !ányí	'our money'
	money		us			

[8] In his representation, an unmarked syllable has the same tone as the preceding one, and with two acute accents on succeeding syllables, the second represents a downstepped High, for example.

[9] Welmers notes that the tonal associative morpheme is absent with singular pronouns as possessives.

I will not attempt a complete analysis of the above data[10], but will limit myself to noting that in all the above examples, the noun on the left, the head noun, ends in a High tone (or downstepped High) when in the associative construction. Thus we conclude that the High associative morpheme docks left to the head noun in Igbo. This is also the analysis proposed in Williamson (1986).

Interestingly, Hyman (1974) (see also Pulleyblank 1997) shows a difference in Igbo dialects in the direction of associative High tone docking. In Central Igbo, presumably the dialect exemplified by Welmers above, the High associative tone docks left, but in the Aboh Igbo dialect, it docks right, to the dependent noun:

(21)	Central Igbo:	àgbà	+	èŋwè	→	àgbá̲ èŋwè	'monkey's jaw'
		jaw		monkey			
	Aboh Igbo:	àgbà	+	èŋwè	→	àgbà ẹ́ŋwè	'monkey's jaw'

Hyman (1974), in a thorough discussion of associative constructions in an appendix, analyzes some associative constructions as having the associative High docking right in Central Igbo (though this is not as clear as the cases in which it docks leftward), but also notes the apparently exceptionless rightward shift of the High in the Aboh dialect.

2.2.9 Benue-Congo:Nupoid

Gwari was classified as Kwa in the Greenberg system, but has been reclassified as in the Nupoid group of New Benue-Congo (Rosendall 1992). As reported in Hyman & Magaji (1970), Gwari has the head noun to the right, to which the associative tone also docks. Gwari has 4 tone levels, the lower mid being unmarked below:

(22)	a.	ēɓí + yàɓà	→	ēɓí yáɓà	'child's banana'
		ēɓí + tnūbwà	→	ēɓí tnúbwà	'child's ear'
	b.	ōsū + yàɓà	→	ōsū yāɓà	'chief's banana'
		ōsū + tnūbwà	→	ōsū tnúbwà	'chief's ear'
	c.	òvyì + yàɓà	→	òvyì yaɓà	'thief's banana'
		òvyì + tnūbwà	→	òvyì tnúbwà	'thief's ear'

The exact phonetic effect of the associative construction varies with the possessor noun on the left. The first syllable of *yaɓa* 'banana,' low in citation form, surfaces as either

[10] The downstep in each example here, for example, is analyzed to be a result of an underlying Low tone at the beginning of each second noun, not a result of its being in an associative construction.

High, Mid, or Lower Mid, depending on the preceding noun. The important generalization is that the tone on *yaɓa* always does raise in this construction. The tone on *tnūbwà* always raises as well. Whatever the tonal features required to account fully for Gwari, it is clear that the tonal effect is on the head noun, to the right.

2.2.10 Benue-Congo: Edoid

In the Edoid languages of Etsako and Bini, a floating High associative morpheme docks left, to the head noun. In Etsako, this can be seen more clearly in the stage before the phonetic representation, which Elimelech describes as "before vowel elision takes place." In both Etsako and Bini, the surface representation, involving as it does elision and/or assimilation of contiguous vowels, makes determination of the direction of floating High docking difficult, but the various workers who have written on these languages all agree that the direction is leftward, perhaps (and this is speculative on my part) based on more careful pronunciation when no vowel elision occurs.

(23) Etsako (Elimelech 1976)

a.	àmè	+	èθà	→	ámé èθà	[ámêθà]	'father's water'
	water		father				
b.	únò	+	èθà	→	únó èθà	[únêθà]	'father's mouth'
	mouth		father				
c.	únò	+	ódzí	→	únóódzí	[únódzí]	'crab's mouth'
	mouth		crab				

In Bini (also called Ɛdo in the literature), we find a similar pattern. Besides the following, also see Amayo (1983), who notes that "in all the instances of tone shifting in Ɛdo, the floating tone moves leftwards" (p. 183).

(24) Bini (Akinlabi 1995, citing Amayo 1976)

òwè	+	ɔsà	→	òwé ɔsà	'chimpanzee's leg'
leg		chimpanzee			

In Engenni, also in the Edoid subgroup, Thomas (1978) reports that the dependent noun ("genitive construct", in her terms) is marked by an upstepped high tone (ˊ). The dependent noun is the second one in Engenni. High tone is unmarked below.

(25)	a.	ɔmù	ɔ̀gà ɔ́mù	'house, side of the house'
		house	side house	
	b.	ùkwô	ɔ̀gà ûkwô	'farm, edge of the farm'
		farm	side farm	

2.2.11 Benue-Congo: Bantoid

Nkem is an Ekoid Bantu language spoken in Cross River State, Nigeria (Sibomana 1986, 1989). It has two types of tonal variations in associative constructions, depending on the noun class of the first noun. If Noun 1 is of the *yó* or *yí* class (in Sibomana's terminology), the associative marker is Low and Noun 2 will either begin with Low or downstepped High, as in (b) below. Nouns in other classes have a High-toned associative marker, and Noun 2 will invariably begin with a High, as in (a) below. (If noun 2 has a nasal prefix, a vocalic associative marker *a* is manifested, which we do not illustrate here.) Constructions which exhibit a tonal change are shown below. Hyphens indicate noun class prefixes.[11] There are more complexities in Nkem than are illustrated here, e.g. kinship nouns do not follow the usual pattern. However, tonal changes due to the associative construction are always on the second noun, which is the head noun.

(26)	a.	ì-bór	+	ì-tàb	→	ì-bór í-tàb	'house top'
		top		house			
		à-ǐŋ	+	ì-tég	→	à-ǐŋ í-tég	'native medicine'
		medicine		house			
	b.	ḿ-bébél	+	í-kób	→	ḿ-bébél ꜜí-kób	'a red cup'
		red		cup			
		ń-kókól	+	í-ríŋ	→	ń-kókól ꜜí-ríŋ	'an old cricket'
		old		cricket			

Makaa (Heath 1991), a Narrow Bantu language of Cameroon, illustrates a rather complex case of associative tonal behavior. There exist three types of associative markers, depending on noun class. Some noun classes have a zero associative marker, some have a segmental morpheme with accompanying High tone, and some are marked

[11] Sibomana 1989 has some different analysis than Sibomana 1986, among which is that Nkem does not have a Mid tone, but rather downstepped Highs. Though some data here is from the 1986 article, the matter of what tones are present is based on the later paper. Thus I have translated the 1986 Mid tones into downstepped Highs, as Sibomana himself does with some data.

by High tone alone. Whether the High tone is floating or associated to a segment, the High docks (or in the case of the segmentally-associated High, spreads) to the prefix of the noun on the right, the dependent noun, as in (a) below. However, if there is no prefix on the second noun, and the first noun ends with a Low-toned open syllable, then the associative High docks left, to the head noun, as in (b). Finally, when there is no prefix on the second noun, and the first noun ends in a closed syllable, an epenthetic vowel appears on it, to which the associative High docks.

(27)	a.	bùdɛ̀	+	mə̀-kwìíndyɛ̀	→	bùdɛ̀ mə́kwìíndyɛ̀	'potato of the posts'
		potato		posts			
	b.	bùdɛ̀	+	jùgà	→	bùdɛ̌ jùgà	'potato of the plug'
		potato		plug			
	c.	cwòlòòmb	+	kààfɛ̀	→	cwòlòòmbʉ́ kààfɛ̀	'unfurled macabo leaf'
		unfurled.leaf		macabo			

Thus Makaa displays different directionality of docking the associative High tone in different contexts. These different patterns will be examined more closely in Section 3.3.4.

In another Narrow Bantu language, Kakɔ, the associative High tone docks right, to the dependent noun (Ernst 1991):

(28)	màl	+	kɔ̀	→	màl kɔ̂	'bachelor's goiter'
	goiter		bachelor			

Bangwa, an Eastern Grassfields language of the Mbam-Nkam subgroup, offers either a floating Low or a floating High tone as associative marker, depending on the noun class (Chumbow & Nguendjio 1991). Though the effect is not visible in (c-d) below, (a-b) show that either associative tone docks left to the head noun. A similar pattern holds with pronominal possessives, e.g. tɛ́ (L) pɛ́ → tɛ̂ pɛ́ 'my father.'

(29)	a.	sú	(L)	ŋwə́	→	sû ŋwə́	'friend of child'
		friend	ASSOC	child			
	b.	mfɔ̀	(H)	lá'	→	mfɔ́ lá'[12]	'chiefs of village'
		chiefs	ASSOC	village			
	c.	fɔ̀	(L)	lá'	→	fɔ̀ lá'	'chiefs of village'
		chiefs	ASSOC	village			
	d.	pwó	(H)	sók	→	pwó sók	'children of bird'
		children	ASSOC	bird			

Bafut, another language of the Mbam-Nkam subgroup in Cameroon, has segmental material as associative morphemes in noun classes 2, 5, 6, and 11, but has only floating tones marking associative constructions for other noun classes. This associative tone is Low for classes 1 and 9 and High for other classes (Ambe 1989, Mfonyam 1989). The head noun in Bafut is on the left, and Ambe has two tone rules specific to the associative construction which interact with other tone rules as well. His first rule docks the Low associative tone left (to the head noun). His second rule docks the associative High to the right (to the dependent noun). Unfortunately, he gives no data to illustrate this. Tamanji (1997) gives some data which partly confirms Ambe's generalizations and partly contradicts it. In Tamanji's data, both High and Low associative tones dock left, to the head noun:

(30)	a.	ɨ̀wùm	(H)	mfɔ̀	→	ɨ̂wŭm mfɔ̀	'chief's figtree'
		figtree		chief			
		nkàà	(H)	bɨ̀sɔ̀rə̀	→	nkāă bɨ̀sɔ̀rə̀	'mermaids' monkey'
		monkey		mermaids			
	b.	lú?ú	(L)	mfɔ̀	→	lú?û mfɔ̀	'chief's spoon'
		spoon		chief			
		ndá	(L)	mísɨ̀	→	ndâ mísɨ̀	'younger one's houses
		houses		younger			

Both writers agree that Low associative tones dock left to the head noun. Compared to other languages in this survey, it is unusual that a floating Low would dock rather than merely creating a downstep. The disagreement between the two writers is in the behavior of the associative High tone. It is possible they are dealing with different dialects, or that each has only considered part of the language. I presently do not have the information

[12] I assume the loss of the original High tone in *mfɔ̀* 'chief' is due to a constraint against rising tones.

needed to resolve this question. Mfonyam (1989) also notes a subset of forms, in class 9, that can dock in either direction, but I have not yet seen the data he bases this on.

Ejagham (Watters 1981) has an associative morpheme i̲ which is Low-toned if the first noun of the construction, the head, is from noun class 1 or 9, and High-toned with other noun classes. If the second noun begins with a vowel, the i̲ deletes, leaving its tone. With a Low associative marker, this remains floating, resulting in downstep, but a High from the associative marker docks right, to the dependent noun:

(31) èkpìn í àtèm → èkpìn átèm 'friend's life'
life ASSOC friend

Bamileke-Dschang (Hyman 1985) is a Bantu language of Cameroon whose tonal complexity is such that it has proved a fertile testing ground for competing theories of tone, particularly in dealing with downstep and related phenomena (see articles in van der Hulst & Snider 1992 for several analyses). It actually has three associative markers --/è/, /é/, /á/, depending on the noun class. The /é, è/ markers are normally deleted in conversation, though often /á/ remains, assimilated to the preceding vowel. The Low tone left behind with deletion of /e/ remains floating, and unfortunately Hyman does not give data with the /é/ class of nouns, which would give a High when the /e/ is deleted. So we cannot test this language at present.

However, for Bamileke-Fe?-fe?, Hyman (1972) gives an explicit account of floating tones in associative constructions. Again, noun classes 1 and 9 take a floating Low associative tone, but other classes take a floating High tone (à, á, a å being High, Low, Mid, and raised Low tones). Underlined tones in the output are meant to indicate joining as tone glides with the preceding word.

(32) a. `thú` + ˊ̲ + `múuˊ → thǔ̲ muu 'child's tree'
tree ASSOC child
b. ŋ̀kéé + ̲̀ + `múuˊ → ŋ̀kee̲ muu

In each case, the associative tone docks left, to the head noun.

Haya (Hyman & Byarushengo 1984) has a High tone inserted only when the possessor is a singular pronoun. This High tone manifests itself on the head noun to the left. They analyze the lack of a High in the cases in (b) below as tone reduction when followed by plural pronouns.

(33)	a)	eki tabó kyange	'my book'	but	b. eki tabo kyáitu	'our book'
		eki tabó kyaawe	'your book'		eki tabo kyáanu	'your.pl. book'
		eki tabó kye	'his book'		eki tabo kyáabo	'their book'

2.2.12 Benue-Congo: Platoid

Eggon is classified by Gerhardt (1989) in the Platoid subfamily of Benue-Congo. Sibomana (1985) gives three examples of associative constructions involving nouns. They are, with Mid tones unmarked and hyphens marking noun class prefixes:

(34)	a.	o-dne → house	a-ʒɛ̃ òdne		'house door' (cf. a-ʒɛ̃ 'door)
	b.	à-bú → dog	i-ʃí èbu		'a dog's head' (cf. i-ʃí 'head)
	c.	à-ʃé → woman	e-ɓí àʃe		'a woman's farm'

This data is intriguing in that in (a) the prefix of the second noun is lowered from Mid to Low, but the stem tone is unaffected, while in (b,c), the prefix, already Low, is unaffected, but the stem tone is lowered from High to Mid. The data in the article is insufficient to offer an analysis of this (though it is tempting to speculate about the possibility of a [-upper] floating morpheme similar to the [+upper] morpheme for Suma in (11)). The point to note for this paper is that the tonal change occurs on the rightmost, nonhead noun.2.2.12 Summary

The following table sums up the preceding presentation of language data.

(35) Typology of directionality and which noun is affected (BC = Benue-Congo)

	Tone docks Left	Tone docks Right
Head noun	Suma: Adamawa-Ubangi Ali: Adamawa-Ubangi Mumuye: Adamawa-Ubangi Kana: BC, Cross River Yoruba: BC, Defoid Central Igbo: BC, Igboid Etsako: BC, Edoid Bini: BC, Edoid Bangwa: BC, Bantu Fe'fe'-Bamileke: BC, Bantu Haya: BC, Bantu Bafut: BC, Bantu Makaa: BC, Bantu[13]	Kɔnni: Gur Moore: Gur Dagbani: Gur Senoufo: Gur Akan: Kwa Gwari: BC, Nupoid Bété: Kru
Dependent noun		Ga'anda: Chadic Efik: BC, Cross River Engenni: BC, Edoid Aboh Igbo: BC, Igboid Bafut: BC, Bantu [14] Makaa: BC, Bantu[11] Kakɔ: BC, Bantu Ejagham: BC, Bantu Nkem: BC, Bantoid Eggon: BC, Platoid

The pattern evident in the table is that an associative tone may dock to the left only if it docks to a head noun. It docks to a dependent noun only if that noun is on the right. Thus the tone can dock to the head noun, or to the right, or both, but never to a dependent noun on the left.

In two languages I know of, the associative tone docks left to a non-head element, but this non-head element is a pronoun. These include Dagbani and the Fante dialect of Akan. Fante contrasts with other dialects of Akan, e.g. Asante.

[11] Note that Makaa has the associative tone on either the head noun or the dependent; this case is discussed in Section 3.3.4.

[14] As discussed above, there is some question of whether Bafut docks an associative High to the right or not.

(36) mɛ̀ hɔ̀hòé 'my guest (Fante)' cf. mɛ̀ hɔ́hɔ̀ɔ́ 'my guest (Asante)'
(data from Dolphyne 1988:70)

For the Gur language Dagbani, Issah (1993:11) notes that the third person singular pronoun is High-toned only when in a possessive construction, as in ó bíhí 'his children.' While further investigation is needed, it seems quite likely that for Dagbani at least, the possessive pronoun is underlyingly toneless, and a floating associative High docks to the empty position in preference to a position which already has a tone present, similar to the Makaa case examined in Section 3.3.4. It is likely the same type of situation also applies in Fante.

3. Analysis

In this section, I discuss two key constraints needed to account for the behavior of the associative tone cross-linguistically, and apply them to the patterns shown above. We have seen in the table in (35) that an associative tone often docks to the head noun. However, when it does dock to a dependent noun, that dependent noun is always to the right. Or, to put it another way, most docking of associative tones is to the right, and when it is to the left, the leftmost noun is always the head noun. It appears, then, that there are two principles involved in determining which noun an associative tone will dock to. The first is that the tone should dock right, and the second is that the tone should dock to the head noun.

3.1 Tone-docking right

In non-associative constructions with floating tones, it is common to find that floating High tones generally associate to the right. Goldsmith (1990) provides an example of this in a non-African language, the Mexican language Mixtec de San Miguel El Grande, using data from Pike (1948). In this Mixtec dialect, some nouns have a suffixal High tone which is underlyingly unassociated. This tone shows its effects on a following word, if one is present. Goldsmith proposes a rule that docks a floating tone to the right.

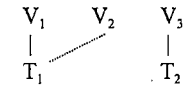
Floating Low tones, in contrast, often remain floating. In African languages with downstep, this floating Low tone can create such a downstep, as in Ga'anda (Kenstowicz 1994), Frafra (Schaefer 1974,1975), Chumburung (Snider 1986), Dɛg (Crouch 1994) and

a host of other more widely-known languages the reader may consult. Most of the discussion in this section will therefore refer to non-Low floating tones.[15]

Lango (Clifton 1975) provides a language which displays both. A floating High tone shows up on the following word, while a floating Low is manifested as downstep.

Interestingly, when there is an empty TBU between two associated tones, and either tone could potentially spread to it, the more usual case is that a tone will associate in a rightward direction. This is illustrated in Clements and Ford's (1979) second tonal association convention, according to which T_1 rather than T_2 will spread to the free vowel V_2 in the configuration below.

(37)



This is concretely illustrated by the tone manifested by Nupe borrowings of Hausa words. Nupe inserts a vowel between the consonant clusters which occur in Hausa. With few exceptions, the tone on the inserted vowel is identical to the tone to its left, not its right (Hyman & Schuh 1974):

(38)

Hausa	Nupe	
àlbárkà	/àlù̱bárı̱kā/	'blessing'
fúskà	/fúsı́kā/	'face'
hár	/hárı́/	'until'

It may be that the tendency toward rightward spreading is also connected to the almost universal left-to-right application of linking tones to TBU's (Odden 1995), with Hausa and Kanakuru being two exceptional languages which display the more marked right-to-left linking. In the case where there are more TBU's than tones (and in a language that spreads rather than fills in vacant TBU's with a default tone), the common result is (39a) rather than (39b):

[15] Of course, in some languages, in some contexts, if there are more tones than TBU's in a word, the excess tones can dock to the word that sponsored them, especially when these words are in citation form or isolation, as in Supyire (Carlson 1985), Kɔnni (Cahill 1992, 1997a), and Chumburung (Snider 1986).

(39) a. T_1 T_2 b. T_1 T_2
| | \ / | |
V_1 V_2 V_3 V_1 V_2 V_3

This would relate to directionality of spreading. In (39a), T_2 has spread to the right. In (39b), T_1 has spread to the left. Thus it is possible that the predominance of left-to-right *association* is a specific consequence of left-to-right *spreading*.

The preponderance of word-final rather than word-initial tonal contours can also be seen as a consequence of rightward spreading. As Hyman & Schuh (1974) note, word-final contours resulting from rightward spreading as in (a) below are relatively common, but word-initial contours as in (b) are rare if they occur at all.

(40) a. T_1 T_2 b. T_1 T_2
| \ | | / |
V_1 V_2 V_1 V_2

It is also relevant that in the common processes of tone movement in Bantu languages, the direction of tone movement is generally to the right. This would include tone "doubling," tone shift, and tone spread (see discussion in Odden 1995 and references therein).

Hyman & Schuh (1974) make the claim, based on their examination of 24 African languages, that tones always spread to the right. Examination of other languages shows that this claim in its absolute form is too strong (cf. Konni *tígè, tí!géhé* 'houses, the houses,' in which the High tone from *hé* spreads leftward -- Cahill 1992, 1998, 1999). However, there does seem to be a strong tendency for languages to spread tones to the right.[16] Besides the African context, it is suggestive, though hardly conclusive, that the only non-controversial cases of spreading in Chinese mentioned in Yip (1995) are rightward, though she does not include a specific discussion of directionality. Silverman (1997) notes in Comaltepec Chinantec of Mexico that all spreading is rightward. Maddieson (1978), drawing from Asian and Meso-American languages as well as African, notes that although there is not "an overwhelming predominance of

[16] Goldsmith (1990:40-41) analyzes Soyaltepec Mazatec (data from E. Pike 1956) as having a leftward High-spread rule. However, his rule also deletes the tone which is to the left of the High, and it is quite possible that the High links to an empty TBU rather than an actively displacing the previous tone by spreading.

perseverative rules," there nonetheless is "a certain excess of perseveration over anticipation." [17] This perseverative spreading of tones contrasts with the tendency for many *segmental* assimilations to be anticipatory, i.e. to spread to the left.

In the preceding discussion, we have seen a clear pattern of directionality of tone movement: spreading right, associating to the right, shifting right. Some attempts at phonetic explanations have been proposed. As an articulatory basis for this perseverative rather than anticipatory effect, Hyman & Schuh (1974) write that the laryngeal adjustments required to regulate pitch changes seem to require more time than articulatory adjustments required to produce successive segments (fn. 3). Silverman (1997) goes into more detail on research on the applicable physiological constraints and reaches the same conclusion. Maddieson (1977) found in an experiment designed to test for a perceptual explanation for perseverative (rightward movement) of tones rather than leftward, that subjects surprisingly tended to perceive ambiguous cases as anticipating the following pitch level rather than perseverative, and noted that if this experiment was confirmed, then "a problem remains in reconciling these experimental data with the linguistic facts." Finally, an experiment by Javkin (1976) found that F_0 change and formant change were judged to occur simultaneously most often when the tone change occurred 10 ms before the formant change, seeming to cause listeners to perceive and thus produce tones as spreading into following segments. Whether an articulatory or perceptual explanation or both turns out to be more explanatory, we can surmise that there is some phonetic basis for the predominant rightward movement of tone.

As a consequence of this pattern, I propose the general constraint **ALIGN TONE-RIGHT**:

(41) **ALIGN TONE-RIGHT: ALIGN (TONE-R, PROSDOM-R)** - align a tone to the right edge of its prosodic domain (**TONE-RT**)

The effect of this constraint aligns any tone to the right edge of its particular domain. This would include the cases of docking a floating tone, spreading a linked tone,

[17] Chumbow & Nguendjio (1991) give data from several constructions in Bangwa which all have floating tones docking to the left. Some of these constructions have heads to the left, as the associative construction and some verbal aspect markers, but some do not. It seems that in Bangwa, and perhaps the entire Mbam-Nkam subgroup, (Hyman & Tadadjeu 1977) TONE-RT is ranked quite low. Maddieson (1978) also reports Villa Alta Zapotec of Mexico to have only leftward assimilations, and several languages with both.

or shifting the position of a tone. In the cases considered in this paper, the domain of the constraint would include the second noun in the associative construction. Of course, other conflicting constraints would prevent a tone from being realized on the last TBU in most cases. For example, LINEARITY, which preserves the serial ordering of elements and penalizes metathesis, would prevent a tone in question from skipping over intervening tones to dock on the last TBU.

TONE-RT will always operate in conjunction with other relevant constraints which motivate a tone change to give direction to the change, producing effects such as the above. For example, the empty TBU's in (37) and the precursors to surface forms in (38) and (39) are filled by spreading. This spreading is the consequence of two constraints: one that disallows toneless TBU's, and one that penalizes insertion of tones. The empty TBU must then get its tone from a neighboring TBU. At this point, TONE-RT comes into play and forces the spreading of tone rightward rather than leftward. In the Mixtec case, a constraint that penalizes floating tones forces the floating tone to dock, and TONE-RT forces the choice of rightward rather than leftward docking. In the Bantu case of tone doubling, there would be constraints against a singly-linked High, and TONE-RT would force the tone to double to its right rather than left. Similarly, with tone shift or spread, various constraints would penalize the underlying position of the tone, and TONE-RT would force the direction of the change.

In the associative cases we will examine here, there will be a constraint penalizing floating tones (or more specifically, floating High tones, since we have seen that floating Lows causing downstep are perfectly acceptable in many African languages), and TONE-RT motivates the choice of the associative tone docking right rather than left.[18]

3.2 Docking to Head Noun

While the motivation for TONE-RT may plausibly be traced to a phonetic basis, the motivation for a constraint causing a tone to dock to the head noun cannot be phonetic. There is no inherent or underlying phonetic difference between head and dependent nouns, but rather a syntactic and semantic difference. It is syntactic in that the

[18] Since TONE-RT is motivated across a wide variety of languages and tonal phenomena, it is quite possible that this could replace the more specific constraints for rightward spreading proposed in other papers. In this schema, TONE-RT would be active, but its scope would be modified by other constraints.

head noun controls agreement and governs the dependent noun. It is semantic in that the head noun is instinctively felt to be the "main" part of what the noun phrase is about. What occurs here in docking of the associative tone to the head, then, is a mapping of phonetic prominence to syntactic/semantic prominence.

This, of course, is regularly done with intonation and stress in English and other languages. When one wants to emphasize or stress a particular component of a sentence, one can change either the pitch or the volume of one's voice for the emphasized element, often, but not always, raising these qualities.

In Balinese, one type of phonetic prominence can be shown to be strictly connected to the syntax, specifically, appearing as a function of the phrase. There is an F0 peak on both the last syllable of the head of the phrase and also on the last syllable of the phrase itself, whether noun phrase or verb phrase (Herman 1997).

Both of these can be viewed as exhibiting *functional* constraints. Investigation of functional constraints with a semantic or syntactic basis is still in the beginning stages. One area where functional constraints have been applied is in the area of vowel elision in hiatus contexts. Casali (1997), in a survey of 87 languages, shows that a vowel in a function word is more likely to elide than one in a lexical word, that an affixal vowel is more likely to elide than one in a root. There is again, a semantic/syntactic function for a constraint.

In the most general way of putting it, we can propose a broad constraint HEAD-PROM as follows:

(42) **HEAD-PROMINENCE (HEAD-PROM)** - if a portion of a phrase is not identical with its underlying representation, it is the head of the phrase which will be phonetically prominent.[19, 20]

Like **TONE-RT**, **HEAD-PROM** is a "steering" constraint: given that other constraints force a change from the underlying representation, these constraints give direction to that change. What constitutes "phonetic prominence" will of course depend on the available features of the language in question. In the context of tonal phenomena

[19] Since in current syntactic theory prepositions are heads of prepositional phrases, but prepositions are rarely phonetically prominent, the constraint should be qualified to exclude prepositional phrases.

[20] Alternatively, the constraint could be cast in more morphological terms, such as "**HEAD-MARKING:** if a morpheme cannot stand alone prosodically, it is associated with its morpho-syntactic head"

and associative morphemes, **HEAD-PROM** will generally interpret a High tone as phonetically prominent, and thus the head noun will attract the High tone of an associative marker.[21] This implies that if a High associative morpheme is sandwiched between two Low-tone nouns, where the direction of docking is easily detectable, **HEAD-PROM** will force the High to dock to the head noun.[22]

3.3 Analysis of Tonal Associative Morphemes

With the two crucial constraints of **TONE-RT** and **HEAD-PROM** in place, we now proceed to an analysis of associative tone docking. In a constraints-based approach, any constraint is violable in principle. Given the two constraints **TONE-RT** and **HEAD-PROM**, we can analyze the patterns of data of associative constructions given in Section 2 by ranking one of these constraints above the other, or by having indeterminate ranking. We will see cases of all of these.

In passing, one may note that the position tonal associative marker on either Noun 1 or Noun 2 is always on the TBU nearest the original position of the floating tone, either the last TBU of Noun 1 or the first TBU of Noun 2. We assume this is due to a LINEARITY constraint, which ensures that there is no metathesis of tones or line crossing. Since this is the situation in all languages mentioned here, I will not discuss it further.

Two additional constraints will be pervasively active in the analysis of tonal associative morphemes. These will be ***(H)** and **MAX-H**:

(43) ***(H)** - floating High tones are not licensed

(44) **MAX-High (MAX-H)** - every High tone in the input must have a correspondent in the output

As we have seen, while floating Low tones giving rise to downstep are allowed and even common in African languages, floating High tones have no comparable widespread phonetic effect. It is commonly assumed they must be associated to make

---

[21] This is the general case, but in some language in which a High may be a default tone, the Low may be the one adding phonetic prominence. In the cases above in which Low is the associative tone, it would be interesting to investigate whether Low or High (or neither) could be considered a default tone.

[22] Tamanji (1997) proposes a constraint that aligns a floating associative tone with the right edge of a head noun (thanks to Martin Jansche for bringing this to my attention). This accounted for the two languages Tamanji examined, but is inadequate for the larger sample examined here.

their presence felt. If not associated, then they delete. (However, I briefly consider the possibility of upstep caused by floating Highs below). In either case, we see that a floating High is not a configuration that is tolerated in these languages. **MAX-H** is one of a family of faithfulness constraints that penalizes deletion of material in the input. For some languages, **MAX-Low** can be combined together with **MAX-H** to give a general **MAX-T**, but in others they must be ranked separately, as we will see in the case of Makaa below. Since we are focusing in this paper on the behavior of a tone which is generally High, I will refer to only **MAX-H** in most of the languages here.

Below I present analyses of one language which has **HEAD-PROM** ranked above **TONE-RT**, one language in which the ranking is reversed, one language in which the ranking is indeterminate, and one language in which another constraint outranks them both and forces variable direction of associative tone docking.

3.3.1 Bini: HEAD-PROM >> TONE-RT

As reported in Akinlabi (1995), Bini has a High tone as associative marker, which docks leftward to the head noun, as in:

(45) Bini (Akinlabi 1995, citing Amayo 1976)

òwɛ̀	+	ɔ̀sà	→	òwɛ́ ɔ̀sà	'chimpanzee's leg', from (24)
leg		chimpanzee			

We illustrate the constraints responsible for *òwɛ́ ɔ̀sà*. In this and all following tableaux, the head noun is underlined for reference. The convention of having dotted lines separate constraints with indeterminate ranking is followed here and in all following tableaux.

(46) HEAD-PROM, *(H), MAX-H >> TONE-RT

UR: òwɛ̀ (ʹ) ɔ̀sà	HEAD-PROM	*(H)	MAX-H	TONE-RT
☞ a. òwɛ́ ɔ̀sà				*
b. òwɛ̀ (ʹ) ɔ̀sà		*!		
c. òwɛ̀ ɔ̀sà			*!	
d. òwɛ̀ ɔ́sà	*!			

In this tableau and the following, I view a floating tone as actually present; how it may be phonetically implemented is an open question and may vary from language to language. One reasonable phonetic interpretation for a High that remains floating is an upstep, similar to downstep caused by a floating Low tone. This would be compatible

with the enriched "register tier" representation of tone proposed by Snider (1990), which has been applied to a number of West African languages successfully (Snider, pc). In this model, besides the High and Low tones, the "register tier" has dynamic autosegments which shift the register up or down. A floating h register, part of a floating High tone, could conceivably raise the entire register of the following tones. The rarity of upsteps in general might indicate that floating Highs are also correspondingly rare, and that *(H) is undominated in almost all languages. In the absence of further evidence, this must remain speculative at this point.[23]

Above, the undominated constraint ***(H)** prohibits floating High tones, forcing the floating associative High to dock. With candidate (b), the High has not docked, and thus incurs a fatal violation of ***(H)**. Candidate (c) has deleted the High altogether and would violate **MAX-H**, which prohibits deletion of High tones, and possibly **HEAD-PROM** as well. In candidate (d), the associative High has docked to the right, to the dependent noun. In some languages this would be allowed, but since **HEAD-PROM** is ranked above **TONE-RT** in Etsako, then the violation of **HEAD-PROM** is fatal. The relative rankings of ***(H)** and **MAX-H** with respect to **HEAD-PROM** cannot be determined from the data considered here, but it is clear that they both outrank **TONE-RT** in Etsako, since violations of ***(H)** and **MAX-H** are fatal, but a violation of **TONE-RT** is not.[24]

3.3.2 Efik: TONE-RT >> HEAD-PROM

In Efik (Ward 1933), there is a High associative tone which docks right, to the dependent noun, as in:

(47)	ìsìm +	àŋwâ	→	ìsìm áŋwâ	'cat's tail', from (17)
	tail	cat			

[23] If a floating High had no phonetic effect at all, it could be universally disallowed, and both the column with the constraint *(H) and the rows with candidates containing floating Highs could be deleted from the tableaux.

[24] Another possible candidate is o̱wē ɔ̀sà, with the High associative merging with the Low to give a Mid. Ruling out this candidate would involve detailed examination of the nature of universal tonal features and how they are played out in Bini. For the present, we will merely note that Bini has no Mid tone, so a constraint *Mid, shorthand for penalizing the combination of tonal features that comprises a Mid tone, could be written to rule out such a candidate

In the tableau below, the same types of candidates are considered as were in the previous section.

(48) TONE-RT, *(H), MAX-H >> HEAD-PROM

UR: ìsìm (ʼ) àŋwâ	TONE-RT	*(H)	MAX-H	HEAD-PROM
☞ a. ìsìm áŋwâ				*
b. ìsìm (ʼ) àŋwâ		*!		
c. ìsìm àŋwâ			*!	
d. ìsím àŋwâ	*!			

Similar to the previous tableau, in candidate (b), the floating High remains floating and fatally violates ***(H)**. In candidate (c), the floating High is deleted altogether, fatally violating Max-H. Candidate (d) keeps the High tone and does dock it to the head noun, but this head is to the left, and in Efik, the highly-ranked **TONE-RT** rules it out. Again, the precise ranking of ***(H)** and **MAX-H** is indeterminate from this data, except that both must be ranked above **HEAD-PROM**.

3.3.3 Konni: indeterminate ranking

In Konni, as analyzed in Cahill (1992, 1999), the associative High docks right to the head noun, as below:

(49) ù + zàsíŋ → ù zá'síŋ 'fish, his fish', from (6)
3sg fish

The same types of candidates and strategy used above are considered below.

(50) Indeterminate ranking

UR: ù (ʼ) zàsíŋ	*(H)	MAX-H	HEAD-PROM	TONE-RT
☞ a. ù zá'síŋ				
b. ù (ʼ) zàsíŋ	*!			
c. ù zàsíŋ		*!		
d. ú zàsíŋ			*!	*!

In this tableau, unlike the others, none of the relevant constraints can be ranked with respect to each other, at least on the basis of this data.[25] Each of the losing

[25] However, from other work (Cahill 1998, 1999) we know that *(H) is undominated, and that at least some spreading in Konni is leftward, so TONE-RT is dominated by other constraints. It is possible that most

candidates violates at least one of the constraints, and candidate (d) violates both of the constraints central to this paper. On the other hand, the winning candidate violates none of these.

3.3.4 Makaa: docking in both directions

In the Optimality Theory framework, constraints are expected to interact with each other, and general patterns may be overridden in specific cases. Thus it is not surprising that we find at least one language in which the associative tone docks left in one set of circumstances and right in others.

Makaa, as analyzed in Heath (1991), illustrates a more complex case of associative tonal behavior than those we have examined. The type of associative marker varies with noun class in Makaa: one associative marker is zero, one is purely tonal, and some consist of segmental material with tone. In this paper, I will concentrate on the associative constructions which are marked by tone alone. In his appendix, Heath gives examples of all pertinent combinations of noun classes and tonal patterns of the associative construction, from which the patterns given below are taken. I am presuming his parentheses around a gloss indicate a particular species or kind of that entity.

(51) Makaa associative construction (syllables with tonal changes are underlined):

a.	bùdɛ̀	+	mə̀-kwìndyè	→	bùdɛ̀ mə̀kwìndyè	'potato of the posts'
	potato		posts			
b.	wáágá	+	mə̀-bágə́	→	wáágá mə́-bágə́	'(vegetable) of the ashes'
	(vegetable)		ashes			
c.	bùdɛ̀	+	jùgà	→	bùdɛ̌ jùgà	'potato of the plug'
	potato		plug			
d.	búgə̀	+	jùgà	→	búgə̌ jùgà	'corner of the plug'
	corner		plug			
e.	wáágá	+	jùgà	→	wáágá jùgà	'(vegetable) of the plug'
	(vegetable)		plug			
f.	bùdɛ̀	+	cáánzə́	→	bùdɛ̀ cáánzə́	'potato of the broth'
	potato		broth			
g.	búgə̀	+	cáánzə́	→	búgə̀ cáánzə́	'corner of the broth'
	corner		broth			
h.	cwòlòòmb	+	kàáfɛ̀	→	cwòlòòmbʉ́ kàáfɛ̀	'unfurled leaf of macabo'
	unfurled.leaf		macabo			

cases of indeterminate ranking may be resolved with a more in-depth investigation of the total tonal system.

Several patterns are evident in the above data. First, (a-b) shows that when there is a prefix available on Noun 2, the associative High tone docks to that prefix (class prefixes are Low when the noun is in citation form, and High in the associative constructions as above). In (c-d), there is no prefix on Noun 2, and we see that if Noun 2 is Low-toned, and Noun 1 ends in a Low tone, the associative tone docks to Noun 1. In (e, f, g) there is also no prefix on Noun 2, and if either Noun 1 or Noun 2 is High-toned, then there is no overt effect of the associative High. Example (h) is similar to (c), except that there is no underlying vowel word-finally in Noun 1 for the associative tone to dock to, so a vowel is inserted.

There are obviously more constraints coming into play in Makaa than the four that we have been using above. The analysis proposed here is somewhat tentative and depends solely on the associative data presented in Heath (1991); hopefully it will be consistent with other tonal patterns in Makaa besides the associative construction.

The first fact we must deal with is that if there is a prefix available on Noun 2, which is the dependent noun, the High docks there. On first examination, it appears that this would not be purely a consequence of the **TONE-RT** constraint, since the High does not dock rightward to a noun stem with no prefix. There is seemingly a distinction made on the basis of the grammatical category of the syllable to the right: right-docking to prefixes is permitted; right-docking to stems is not.

However, we must ask if there is any phonological characteristic of the prefix, aside from its morphological category, which might make it amenable to High-docking. There is a definite possibility available. In many Bantu languages, a Low tone is the default tone, added only in places where Highs are not associated. Added to this general tendency is the propensity of affixes to be unspecified for tone. Considering these factors, we can see there is quite a high likelihood that the prefix is unspecified for tone in underlying representation. If so, then in citation form, the prefix receives a Low tone by default, but in the associative construction, the floating High tone associates to the empty TBU of the prefix.[26]

[26] Another possibility, suggested by David Odden, is that MAX-T for affixes is ranked more lowly than MAX-T for stems, and thus affixes would be more vulnerable to permutation of tones than stems would. This suggestion is promising but will not be pursued here.

The other patterns, illustrated by (51c-h) above, are that the floating High either docks left or seemingly has no effect.

Phonetically, we cannot discriminate between the floating High docking to a noun with a High already present and its deleting, since the same phonetic result is obtained if the floating High either docks, merging with the already-present High, or deletes altogether. Since there is no phonetic difference, the issue must be decided on theory-internal grounds. In any autosegmentally-based model, two High tones on a single TBU is an unlikely configuration, ruled out by an OCP effect or, more basically, by a literal application of Occam's Razor: "do not multiply entities needlessly". Having two (or more) identical tones residing on a single TBU is certainly multiplying entities needlessly. So let us consider that configurations in which the High docks to a TBU with an existing High are ruled out by an undominated constraint prohibiting two identical tones associated to the same TBU; let us call this constraint ***2TONE**. Such configurations will not be further considered in the analysis to follow. So in the absence of a prefix on Noun 2, the associative patterns for Makaa may be generalized as the following.

Delete the associative High if Noun 1 or Noun 2 is High; otherwise dock left.

This formulation gives a credible motivation for the output; delete a High when it is adjacent to another High. We will briefly consider two plausible approaches based on this statement, but reject them in favor of an alternative. One approach is to propose a constraint *STRAY which deletes a floating High when adjacent to another High. This is a shorthand of a type sometimes used (e.g. the SPREAD constraint in Padgett 1995), but it is actually stated in the form of a rule ("do X in environment Y") rather than as a true constraint or constraints that would be needed. We will avoid such a pseudo-constraint and use more general constraints to account for this pattern.

It is also possible that a form of the OCP could be relevant here, but Heath (1991:6) specifically distinguishes between noun stems which have only one High in underlying representation and those which have two, so presumably the OCP cannot be an absolute prohibition against adjacent Highs in Makaa. The OCP here would thus have to specifically refer to a floating High, so this OCP constraint would not do more than the ***(H)** which is already in place. Finally, as we will see below, the cases in which an OCP-like constraint might be called upon have alternatives that will account for the data.

As a first step toward a solution, let us start with the situation which has the fewest complexities, the case in which the High tone is bordered by two nouns each having all Low tones in citation form. We see that given this simple choice, the High tone docks leftward to the head noun, showing that of the two main constraints proposed in this paper, **HEAD-PROM** is ranked above **TONE-RT**.

(52) bùdě jùgà 'potato of the plug': *(H), HEAD-PROM >> TONE-RT

UR: bùdè (ˈ) jùgà	*(H)	HEAD-PROM	MAX-H	TONE-RT
☞ a. bùdě jùgà				*
b. bùdè (ˈ) jùgà	*!			
c. bùdè júgà		*!		
d. bùdè jùgà			*!	

In this tableau, similar to preceding ones, candidate (a) wins, even though it does violate **TONE-RT**. The losing candidates (b, c, d) violate either **HEAD-PROM**, ***(H)**, or **MAX-H**, showing that these constraints must be ranked above **TONE-RT**. In fact, **TONE-RT** is ranked low enough in Makaa so that it rules out no candidates in the data examined here and so will be omitted in the following tableaux.

In a phrase with a High tone on the last syllable of Noun 1 (the head noun), **HEAD-PROM** will not be violated, and two constraints which are independently needed in Makaa are active in this context. In common with many languages, Makaa has no word-initial contours. This quite probably has a relation with the TONE-RT principle which deserves further investigation, but as a surface constraint let us formulate it for now as follows:

(53) ***#CONTOUR (*#CONT)** : word-initial tone contours are disallowed

The constraint **MAX-LOW**, penalizing deletion of Low tones, is also active in the next two tableaux:

(54) **MAX-LOW (MAX-L):** every Low tone in the input has a correspondent in the output

The tableau for '(vegetable) of the plug' will then be:

(55) wáágá jùgà '(vegetable) of the plug': *#CONT, *(H), MAX-L >> MAX-H

(55) wáágá jùgà '(vegetable) of the plug': *#CONT, *(H), MAX-L >> MAX-H

UR: wáágá (ˊ) jùgà	*#CONT	*(H)	MAX-L	HEAD-PROM	MAX-H
☞ a. wáágá jùgà					*
b. wáágá (ˊ) jùgà		*!			
c. wáágá jûgà	*!				
d. wáágá júgà			*!		

Candidate (a) is optimal in spite of its violation of **MAX-H**. Other candidates are ruled out by violations of ***#CONT**, ***(H)**, or **MAX-L**. **HEAD-PROM** is not violated by any of these candidates.

In the discussion of a phrase which has a noun with High tone on Noun 2, a specific constraint ***RISE-HIGH** must be included. In Heath's data, we notice that all instances of a rising tone have a Low tone following. There is no instance of Rise-High. With the suspicion that there is possibly some deeper generalization present (again, with a possible link to **TONE-RT**), for our purposes here I propose for Makaa the constraint ***R-H**:

(56) ***RISE-HIGH (*R-H):** a Rise-High sequence of tones is prohibited.

With this constraint in place, we present the tableau for 'potato of the broth.'

(57) bùdɛ̀ cáánzə 'potato of the broth': *R-H, *(H), MAX-L >> HEAD-PROM

UR: bùdɛ̀ (ˊ) cáánzə	*R-H	*(H)	MAX-L	HEAD-PROM	MAX-H
☞ a. bùdɛ̀ cáánzə				*	*
b. bùdɛ̀ (ˊ) cáánzə		*!			
c. bùdɛ̌ cáánzə	*!				
d. bùdɛ́ cáánzə			*!		

Above, in the winning candidate, the floating High does not show up on Noun 1 and so this candidate violates **HEAD-PROM**. However, other candidates violate other constraints, which must therefore be more highly ranked than **HEAD-PROM**. Candidate (b) violates ***(H)** by the High remaining floating. Candidates (c,d) violate ***R-H** or **MAX-L**, and shows that in this case in Makaa, ***(H)** would rather be satisfied by deletion of the High than by docking to the head noun.

With the above constraints in place, we can turn to the last two cases, in which the associative High docks to the prefix of Noun 2. In the first case, we see that it is better in Makaa to link the High present in underlying representation to the toneless TBU than to

insert a default Low, which is what happens when there is no extra floating tone available. We propose a constraint *TONELESS:

(58) ***TONELESS TBU (*TONELESS)** - every TBU must have a tone linked to it.

The constraint **DEP-L** also comes into play here, penalizing insertion of a Low.

(59) **DEP-L** - every Low tone in the output has a correspondent in the input

***(H)** is undominated in Makaa, but in the citation form *mə̀–kwìindyè* we see that Low tone may be inserted on the prefix, violating **DEP-L.** So ***(H)** outranks **DEP-L.** Below we see also that **DEP-L** must outrank **HEAD-PROM.**

(60) bùdɛ̀ mə́kwìindyè 'potato of the posts': DEP-L >> HEAD-PROM

UR: bùdɛ̀ (') mə-kwìindyè	*TONELESS	*(H)	DEP-L	HEAD-PROM	MAX-H
☞ a. bùdɛ̀ mə́kwìindyè				*	
b. bùdɛ̌ mə̀kwìindyè			*!		
c. bùdɛ̀ (') mə̀-kwìindyè		*!	*		
d. bùdɛ̌ məkwìindyè	*!				
e. bùdɛ̀ (') mə̀-kwìindyè		*!	*	*	
f. bùdɛ̀ məkwìindyè	*!			*	*

Finally, the same constraints also account for the case of Noun 2 having a prefix and Noun 1 being High-toned.

(61) wáágá mə́-bágə́ '(vegetable) of the ashes':

UR: wáágá (') mə-bágə́	*TONELESS	*(H)	DEP-L	HEAD-PROM	MAX-H
☞ a. wáágá mə́-bágə́					
b. wáágá (') mə-bágə́	*!	*!			
c. wáágá mə-bágə́	*!				*
d. wáágá (') mə̀-bágə́		*!	*		
e. wáágá mə̀-bágə́			*!		*

Candidate (a) violates no constraints. Candidates (b,c) violate the undominated ***TONELESS.** The interesting losing candidates are (d, e), in which we see that it is better to dock the present High to the toneless prefix than to insert a default Low. The undominated constraint ***(H)** rules out (d), while **DEP-L** rules out (e).

Constraints needed for Makaa, then, are the following. The bolded constraints are the ones needed for the previously analyzed languages; unbolded ones are new for the Makaa analysis.

(62) ***(H)**
*TONELESS >> DEP-L >> **HEADPROM** >> **MAX-H** >> **TONE-RT**
*R-H
*#CONT MAX-L >>

In the crucial ranking **HEADPROM** >> **TONE-RT**, Makaa most closely resembles the Etsako pattern above, although with the limited data we examined for Etsako, no determination was made of other constraints' rankings.

In this project, I have shown that patterns in docking of tonal associative morphemes are not random, but are the result of interaction of two key constraints, **TONE-RT** and **HEADPROM**, both of which are well-supported by cross-linguistic evidence.

References

Akinlabi, Akinbiyi. 1996. Featural Affixation. Journal of Linguistics 32.2:239-289.

Ambe, Henry Suh Achuo. 1989. The Structure of Bafut, Vols. I & II. Ph.D dissertation, Georgetown University.

Amayo, M.A. 1976. A generative phonology of Edo (Bini). Ph.D. dissertation, University of Ibadan.

Amayo, Airen. 1983. Tone Rules and Derivational History in Ɛdo Phonology. In Ivan R. Dihoff (ed.) Current Approaches to African Linguistics (vol. 1). Dordrecht: Foris Publications.

Bendor-Samuel, John (ed). 1989. The Niger-Congo Languages. SIL/University Press of America.

Bradshaw, Mary M. 1995a. Tone on Verbs in Suma. In Akinlabi, Akinbiyi (ed.) Theoretical Approaches to African Linguistics. Trenton, NJ: Africa World Press, Inc.

Bradshaw, Mary M. 1995b. Unrecoverable Origins and Derivational Residues: Tonal Alternations in Suma Nouns. Paper presented at Tilburg, The Netherlands.

Cahill, Michael. 1992. A Preliminary Phonology of the Kɔnni Language. Collected Language Notes No. 20. Legon: Institute of African Studies, University of Ghana.

Cahill, Michael. 1998. Tonal Polarity in Kɔnni Nouns: An Optimal Theoretical Account. OSUWPL No. 51:19-58.

Cahill, Michael. 1999. Aspects of the Morphology and Phonology of Kɔnni. Ph.D. Dissertation, Ohio State University.

Casali, Roderic F. 1997. Vowel Elision in Hiatus Contexts: Which Vowel Goes? Language 73.3: 493-533.

Charette, Monik. 1983. La construction associative in bété de gbadi. In Jonathan Kaye, Hilda Koopman, Dominique Sportliche, and André Dugas (eds.), Current Approaches to African Linguistics (vol. 2). Dordrecht: Foris Publications, pp. 99-126.

Chumbow, Beban S., and Emile G. Nguendjio. 1991. Floating tones in Bangwa. JWAL XXI,1:3-14.

Clements, G.N., and K.C. Ford. 1979. Kikuyu tone shift and its synchronic consequences. Linguistic Inquiry 10:179-210.

Clifton, John M. 1975. Nonsegmental Tone in Lango. Proceedings of the Sixth Conference on African Linguistics. OSU Working Papers in Linguistics 20:99-105.

Cowan, J. Ronayne, and Russell J. Schuh. 1976. Spoken Hausa. Ithaca, NY: Spoken Language Services, Inc.

Crouch, Marjorie. 1994. Phonology of Dɛg. ms. Ghana Institute of Linguistics, Literacy, and Bible Translation, Tamale, Ghana.

Dolphyne, Florence. 1986. Tone and Grammar in Akan. The Tone of Possessive Constructions in the Asante Dialect. In Koen Boegers, Harry van der Hulst, and Maarten Mous (eds.), the Phonological Representation of Suprasegmentals. Dordrecht: Foris Publications.

Dolphyne, Florence Abena. 1988. The Akan (Twi-Fante) Language: Its Sound Systems and Tonal Structure. Accra: Ghana Universities Press.

Elimelech, B. 1976. A tonal grammar of Etsako. UCLA Working Papers in Phonetics 35.

Ernst, Urs. 1991. Description tonologique de l'énoncé nominal associatif en kako. In Anderson, Stephen C. (ed). Tone in Five Languages of Cameroon. Dallas: Summer Institute of Linguistics.

Gerhardt, Ludwig. 1989. Kainji and Platoid. In Bendor-Samuel (1989).

Goad, Heather. 1988. Tone in the Dagbani Noun Phrase. ms, Univerity of Southern Calfornia.

Goldsmith, John. 1990. Autosegmental and Metrical Phonology. Cambridge: Basil Blackwell, Inc.

Greenburg, Joseph. 1966. Some Universals of Grammar with Particular Reference to the Order of Meaningful Elements. In Joseph Greenburg (ed.), Universals of Language (2nd ed.). Cambridge, MA: MIT Press.

Heath, Daniel. 1991. Tone in the Makaa Associative Construction. In Anderson, Stephen C. (ed). Tone in Five Languages of Cameroon. Dallas: Summer Institute of Linguistics.

Herman, Rebecca. 1997. Syntactically Governed Accentuation in Balinese. OSU Working Papers in Linguistics 50: Papers from the Linguistics Laboratory, pp. 69-99.

Hyman, Larry M. 1972. A Phonological Study of Fe'fe'-Bamileke. Ph.D. Dissertation, UCLA.

Hyman, Larry M. 1974. The Great Igbo Tone Shift. In Erhard Voeltz (ed.) Third Annual Conference on African Linguistics. Bloomington: Indiana University

Hyman, Larry M. 1985. Word domains and downstep in Bamileke-Dschang. Phonology Yearbook 2:45-82.

Hyman, Larry M., and Ernest Byarushengo. 1984. A model of Haya tonology. In G.N. Clements and J. Goldsmith (eds.), Autosegmental Studies in Bantu Tone (pp. 53-103). Dordrecht: Foris.

Hyman, Larry M., and Daniel J. Magaji. 1970. Essentials of Gwari Grammar. Occasional Publication No. 27, Institute of African Studies, University of Ibadan.

Hyman, Larry M., and Russell G. Schuh. 1974. Universals of Tone Rules: Evidence from West Africa. Linguistic Inquiry 5:81-115.

Hyman, Larry M., and M Tadadjeu. 1977. Floating Tones in Mbam-Nkam. In Hyman, Larry M. (ed.) Studies in Bantu Tonology. SCOPIL:57-111.

Ikoro, Suanu M. 1995. A New Approach to Tones in Associative Constructions: Insights from Kana. In E. 'Nọlue Emenjoọ and Ozo-mekuri Ndimele (eds.) Issues in African Languages and Linguistics: Essays in Honour of Kay Williamson. Aba, Nigeria: National Institute for Nigerian Languages.

Issah, Dawuni. 1993. Some Tonal Processes and Tone Representation in Dagbani. M.A. Thesis, University of Texas at Arlington.

Javkin, Hector. 1976. Auditory basis of progressive tone spreading [abstract]. Journal of the Acoustical Society of America 60, Supp. 1:S45.

Kenstowicz, Michael. 1994. Phonology in Generative Grammar. Cambridge, MA: Basil Blackwell, Inc.

Maddieson, Ian. 1977. Tone spreading and perception. UCLA Working Papers in Phonetics 36:84-90.

Maddieson, Ian. 1978. Universals of Tone. In Greenberg, Joseph (ed.) Universals of Human Language, pp. 335-365. Stanford: Stanford University Press.

Mills, Elizabeth. 1984. Senoufo Phonology, Discourse to Syllable (A Prosodic Approach). Dallas: Summer Institute of Linguistics.

Monino, Y. 1987. La determination nominale en gbaya-manza: choix a la carte ou menu impose? In P. Boyeldieu, La Maison du Chef et la Tete du Cabri.

Nichols, Johanna. 1986. Head-marking and dependent-marking grammar. Language 62.1:56-119.

Nyaggah, Lynette. 1976. Associative Tone and Syllable Structure in Asante Twi. Studies in African Linguistics, Supplement 6:191-200.

Odden, David. 1995. Tone: African Languages. In John Goldsmith (ed.) The Handbook of Phonological Theory. Cambridge, MA: Basil Blackwell.

Padgett, Jaye. 1995. Feature Classes. In Papers in Optimality Theory, University of Massachusetts Occasional Papers in Phonology 18, GLSA, Umass Amherst, pp. 385-421.

Peterson, Thomas H. 1971. Mooré Structure: A Generative Analysis of the Tonal System and Aspects of the Syntax. Ph.D. dissertation, UCLA.

Pike, Evelyn. 1956. Tonally Differentiated Allomorphs of Soyaltepec Mazatec. International Journal of American Linguistics 22:57-71.

Pike, Kenneth. 1948. Tone Languages: a technique for determining the number and type of pitch contrasts in a language, with studies in tonemic substitution and fusion. University of Michigan Publications in Linguistics, no. 4. Ann Arbor: University of Michigan Press.

Prince, Alan, and Paul Smolensky. 1993. Optimality Theory: Constraint Interaction in Generative Grammar. Ms, Rutgers University and University of Colorado at Boulder.

Pulleyblank, Douglas. 1997. Optimality Theory and Features. In Diane Archangeli and D. Terence Langendoen (eds.), Optimality Theory: An Overview. Malden, MA: Blackwell Publishers.

Rosendall, Heidi James. 1992. A Phonological Study of the Gwari Lects. Dallas: Summer Institute of Linguistics.

Schaefer, Robert. 1974. Tone in Gurenne. Anthropological Linguistics vol.16, no. 9. Indiana University, Bloomington, Indiana.

Schaefer, Robert. 1975. The Phonology of Frafra. Collected Field Notes Series No. 15. Legon: Institute of African Studies, University of Ghana.

Sibomana, Leo. 1986. An Outline of Nkem Language. Afrika und Übersee 69,2:251-292.

Sibomana, Leo. 1989. The Tonal System of Nkem. Afrika und Übersee 72,2:255-272.

Silverman, Daniel. 1997. Tone sandhi in Comaltec Chinantec. Language 73.3:473-492.

Snider, Keith. 1986. Apocope, tone, and the glottal stop in Chumburung. JALL 8:133-144.

Snider, Keith. 1990. Tonal Upstep in Krachi: Evidence for a Register Tier. Language 66: 453-474.

Tamanji, Pius N. 1997. Tone Docking and Generalized Alignment. ms., University of Massachusetts, Amherst.

Thomas, Elaine. 1978. A Grammatical Description of the Engenni Language. Dallas: Summer Institute of Linguistics.

Van der Hulst, Harry, and Keith Snider. 1992. The Phonology of Tone: The Representation of Tonal Register. Berlin: Mouton de Gruyter.

Ward, Ida C. 1933 The Phonetic and Tonal Structure of Efik. Cambridge: W. Heffer & Sons, Ltd.

Watters, John R. 1981. A Phonology and Morphology of Ejagham--with Notes on Dialect Variation. Ph.D. dissertation, UCLA.

Welmers, William. 1963. Associative *a* and *ka* in Niger-Congo. Language 39:432-447.

Welmers, William. 1970. Igbo Tonology. Studies in African Linguistics 1:255-278.

Welmers, William. 1973. African Language Structures. University of California Press.

Williamson, Kay. 1986. The Igbo Associative and Specific Constructions. In Koen Boegers, Harry van der Hulst, and Maarten Mous (eds.), the Phonological Representation of Suprasegmentals. Dordrecht: Foris Publications.

Yip, Moira. 1995. Tone in East Asian Languages. In John Goldsmith (ed.) The Handbook of Phonological Theory. Cambridge, MA: Basil Blackwell.